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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/059,588

01/28/2002

Michael R. Krames

M-11547 US

5828

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7590

05/28/2003

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EXAMINER

WILLE, DOUGLAS A

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 05/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/059,588

Applicant(s)

KRAMES ET AL.

Examiner

Douglas A Wille

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 04 April 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-46 and 93-98 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-46 and 93-98 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1 – 3, 6 – 23, 25 - 28 and 32,33, 36 – 46, 93, 94, 96 and 97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Joannopoulos et al. in view of Imada et al. and Vaudo et al.
3. With respect to claims 1 and 25, Joannopoulos et al. show a light emitting structure (see cover Figure and column 3, line 22 et seq.) where a periodic array of holes, which could be triangular (column 5, line 2), is provided and the material is GaAs (column 7, line 51) but do not show the spacing of the holes or an electrode structure. Imada et al. show a laser structure with a triangular lattice in InGaAsP and show a lattice constant of 0.462 microns with an active layer with a gap of 1.3 microns. Vaudo et al. shows a GaN based light emitting diode using (Ga, Al, In)N (see cover Figure and abstract). It would have been obvious to use the GaN material system instead of the GaAs shown by Joannopoulos et al. to provide a wider range of available wavelengths. It would have been obvious to use the lattice constant shown by Imada et al. in the Joannopoulos et al. device since it results in a working device. In the Imada et al. device the periodicity to wavelength ratio is in the range of 0.1 – 5 and both references show III-V materials. Note that Joannopoulos et al. show the holes as passing through the upper layer and

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the active layer and therefore the thickness of the second semiconductor layer is less than the wavelength of emitted light.

4. With respect to claims 2 and 28, Joannopoulos et al. show a p-n junction (column 7, line 47).

5. With respect to claim 3, the substrate is doped GaAs and it would therefore be obvious to use an electrode on the bottom of the device since the complexity of forming a mesa can be avoided.

6. With respect to claims 6 and 27, the surface recombination velocity is inherent in the structure.

7. With respect to claim 7, the elements of Joannopoulos et al. and Imada et al. are both III-V.

8. With respect to claims 9 and 32, the periodic structure is periodic in the plane of the structure.

9. With respect to claims 10 – 12, 33, the holes define the minima.

10. With respect to claims 13, 14, 36 and 37, Joannopoulos et al. show the array can be triangular, hexagonal, square or honeycomb (column 5, line 2).

11. With respect to claims 15 and 38, Joannopoulos et al. show that only the guided modes are polarized and the radiation modes show no polarization dependence.

12. With respect to claims 16 and 39, Joannopoulos et al. show the holes can be filled with a dielectric (column 8, line 13).

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13. With respect to claims 17 and 40, silicon oxide is a dielectric that has a low index and is commonly used with semiconductors and it would therefore be obvious to use it as a dielectric as a design alternative.

14. With respect to claims 18, 19, 41 and 42 emission at or near the band edge is inherent in the function of the device.

15. With respect to claims 20 and 43, Imada et al. show a fill factor of 0.2 (page 316, second column) and the dielectric constant runs between that for air and semiconductors.

16. With respect to claims 21 and 44, the extraction efficiency (column 4, line 5) is 70 % (column 5, line 59).

17. With respect to claim 8, Vaudo et al. shows a GaN based Light emitting diode using (Ga, Al, In)N (see cover Figure and abstract). It would have been obvious to use the GaN material system instead of the GaAs shown by Joannopoulos et al. to provide a wider range of available wavelengths.

18. With respect to claim 26, the material is III-V.

19. With respect to claims 22, 23, 45 and 46, Joannopoulos et al. show that the gaps in the emission occur for various values of  $c/a$  and it would have been obvious to design the device to meet specific requirements as a matter of design optimization. Note that Vaudo et al. shows that the active layer is InGaN (column 13, line 41) and the electrode materials are the standard materials for this material system.

20. With respect to claims 93, 94, 96 and 97. Joannopoulos et al. shows the holes as extending through the layers.

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21. Claims 4, 5, 29, 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Joannopoulos et al. in view of Imada et al., Vaudo et al. and further in view of Kurahashi.

22. Joannopoulos et al. and Imada et al. do not show the electrode structure and Kurahashi shows an electrode structure with a DBR on a substrate to provide surface emission where resistance increase is prevented. It would have been obvious to use such a structure for the advantages shown for those cases where substrate contacts are not possible such as with sapphire.

23. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Joannopoulos et al. in view of Imada et al. and further in view of Roberts et al.

24. The basic device is an emitter structure without a housing, which would be necessary to make a finished device. Roberts et al. show a finished package that includes (see cover Figure and column 9, line 3 et seq.) a lead frame 205, heat sink 204 and transparent encapsulant 203.

25. Claims 95 and 98 are rejected under 35 U.S.C. 103(a) as being unpatentable over Joannopoulos et al. in view of Imada et al., Vaudo et al. and further in view of Dodabalapur et al.

26. Dodabalapur et al. show the use of a one-dimensional photonic crystal as a distributed feedback laser with the grating in the active layer (column 5, line 32). It would have been obvious to form this structure since it is a known variation of a laser structure.

#### *Response to Arguments*

27. Applicant's arguments filed 4/4/03 have been fully considered but they are not persuasive.

28. Applicant states that Joannopoulos et al. do not show an electrode but note that since an improvement in an LED structure is described, an electrode structure is a necessity and is

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obvious but note that Imada et al. specifically show an electrode and its incorporation is obvious. Also note that Imada et al. show a triangular structure and its application to the basic structure is obvious despite differences in the layer structure.

29. Regarding the inherency of the surface recombination velocity, see the combination of the basic references with Vaudo et al.

30. With respect to the inherency of operation at the band edge, note that Joannopoulos et al. show it (column 5, line 56).

31. With respect to comments about a nitride material note that Vaudo et al. show the nitride material. It would be obvious to extend the photonic crystal concept to any direct bandgap semiconductor material.

### *Conclusion*

32. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

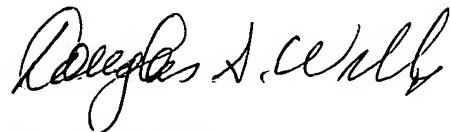
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas A Wille whose telephone number is (703) 308-4949. The examiner can normally be reached on M-F (6:15-2:45).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A handwritten signature in black ink, appearing to read 'Douglas A. Wille', written in a cursive style.

Douglas A. Wille  
Primary Examiner

May 21, 2003